λ 4567·90, and λ 4574·79. The values obtained by previous observers are given below for comparison:—

	λ	λ	λ
Gill (from stars)	4552·79 ...	4567·90 ...	4574·68
McClean (from stars)	4552·6 ...	4567·5 ...	4574·5
Lockyer (spark)	4552·8 ...	4568·0 ..	4574·9
Exner and Haschek (spark)..	4552·75 ..	4567·95 ...	4574·9

The importance of having the exact wave-lengths of these lines in stellar radial-velocity determinations is shown by the differences which would be introduced into Prof. Frost's recent work on the *Orion* stars by the change from Exner and Haschek's values, as given above and previously used by Prof. Frost, to the new wave-length values. They are as follow:—

	Correction (Frost and Brown.—Exner and Haschek)		
λ	In λ		In kilometres
4553 ...	−0·114 tenth-metres	...	= −7·51
4568 ...	−0·053 ,,	...	= −3·48
4575 ...	−0·109 ,,	...	= −7·14

REPORT OF THE YERKES OBSERVATORY.—Prof. Hale's report of the work performed at the Yerkes Observatory during the year ended June 30, 1904, has just been received, and shows that, during that period, neither the results obtained nor the private pecuniary support accorded to the institution fell below the average of previous years.

The Carnegie Institution of Washington has renewed the grant of 4000 dollars made to the observatory for the previous year, and the money is to be employed in furthering the investigations of stellar parallaxes, the observations of variable stars, and the reduction of the solar photographs obtained with the spectroheliograph of the Kenwood Observatory during the years 1892–5.

The Snow telescope, which was destroyed by fire in December, 1902, has been rebuilt from a gift of 10,000 dollars made by Miss Snow, and has since been erected at the Mount Wilson Solar Observatory.

A gift of a further 10,000 dollars from the Carnegie Institution provided for an expedition, for solar research, to Mount Wilson, where an independent observatory has since been erected under the direction of Prof. Hale, who thus severs his more immediate connection with the Yerkes Observatory.

The Bruce telescope having an aperture of 10 inches and a focal length of 50 inches has now been completed, and, under the direction of Prof. Barnard, is yielding splendid results. This telescope gives sharp definition over a field about 9° in diameter.

The 40-inch refractor is used for the Rumford spectroheliograph, the Bruce spectrograph, and several other attached instruments, and continues to give increased satisfaction.

After describing the above, Prof. Hale gives a somewhat detailed account of the excellent work performed in each department, and thereby shows what an important place in the astronomical world is filled by the Williams Bay observers and observatory.

OBSERVATIONS OF JUPITER'S SIXTH SATELLITE.—The results of a series of photographic observations of Jupiter's sixth satellite, made at Greenwich with the 30-inch reflector of the Thompson equatorial during August, September, and October, are published in No. 4051 of the *Astronomische Nachrichten*. Thirteen photographs were obtained on eight nights, and the time and length of each exposure, and the position angle and distance determined therefrom, are given in the table published. So far as possible, the two latter quantities have been compared with those given by Dr. Ross's ephemeris which appeared in No. 4042 of the *Astronomische Nachrichten*, and the differences are appended.

In order to facilitate the measuring process, the over-exposed image of Jupiter, on each plate, was reduced with ferricyanide of potassium, leaving an easily measurable reversed image, but the present results are to be considered as only provisional.

THE SPECTRUM OF NOVA PERSEI No. 2.—No. 3, vol. lvi., of the Harvard College Observatory Annals contains a detailed *résumé* of the spectroscopic results obtained at the observatory in connection with Nova Persei No. 2.

Particulars of the photographs obtained are first given, and then each plate is discussed in order, and a description of the spectral changes and of the principal lines in the spectrum given. Special remarks are made in reference to any peculiar appearance or changes in the spectrum, such as took place when the star was rising to its maximum brightness and subsequently when its magnitude was oscillating. In this connection an interesting comparison is drawn between the changes which take place in the spectrum of Mira Ceti during the light-variations of that star and those which were observed in the Nova spectrum. From this comparison it is deduced that both in the case of Novæ and variable stars of long period the hydrogen lines do not become bright until the star has attained a large portion of its light.

REDUCTION TABLES FOR EQUATORIAL OBSERVATIONS.—Appendix No. 3 to vol. iv. of the Publications of the U.S. Naval Observatory contains a series of tables for the reduction of equatorial observations.

These tables have been compiled by Mr. C. W. Frederick, who, in the introduction to them, develops the formulæ for the construction of the tables of differential refraction for micrometer observations made with an equatorial, describes a method of determining the instrumental constants, and explains the use of the six tables included in the work.

The first three tables show the corrections for differential refraction, for the latitude of the Washington Observatory, to be applied separately according to the method of observation pursued.

Tables iv., v., and vi. give the instrumental constants of the 26-inch equatorial, of the Naval Observatory, for use under analogous conditions.

PHOTOGRAPHIC STAR CATALOGUE.—From a communication made by M. Lœwy to the Paris Academy of Sciences, we learn that the first volume of the "Catalogue photographique du Ciel" has been published by the Bordeaux Observatory, relating to the region dec. +16° to +18°, which they undertook to observe. This volume contains the rectilinear coordinates of 49,772 stars, and completes the set of four similar publications undertaken by the French observatories (Algiers, Paris, Toulouse, and Bordeaux) as part of the international cooperative scheme (*Comptes rendus*, October 9).

GEOGRAPHY AT THE BRITISH ASSOCIATION.

IN arranging the programme of work for the South African meeting, the organising committee of Section E tried to secure papers summarising the geographical conditions of the "subcontinent," as it is locally called, or those dealing with general geographical problems. The number of papers by South Africans was smaller than might have been expected, the local committee discovering that geography was the subject for which it was most difficult to secure papers. South Africa is in the position of having many specialists interested in geographical aspects of their specialisms, but has as yet no geographers giving all their time and energy to the subject.

In spite of this, the programme of the section was a full one, and it would have been difficult to dispose of more business than was accomplished.

It will be most convenient to consider first those papers which deal with Africa.

Mr. H. C. Schunke Hollway, vice-president of the section, communicated a paper on the outlines of the physical geography of the Cape Colony. This was illustrated by a new orographical map specially prepared by the Surveyor-general, Mr. Cornish-Bowden, showing contour lines at 1500, 3000, 4000, 6000, and 8000 feet. Unfortunately, sufficient data for plotting the 500-feet contour line—one of the most interesting of all—do not exist; and even the lines shown on this map are only approximations. Here, at the outset, the lack of a good topographical map was bewailed, and throughout the wanderings of the members in South Africa this deficiency was felt at every

turn. Mr. Schunke Hollway traced the first efforts to obtain levels, and showed how the railway surveys had been the chief means of securing the knowledge we possess of relief. He then discussed the natural divisions of the Cape Colony, distinguishing (1) the coast, and (2) the Orange River basin. The coast, varying from 80 miles to 170 miles wide, he divided into (*a*) the eastern region, a narrow tract of land which rose in terraces from the sea, east of the south-east sweep of the Sneeuwbergen, Tandjesbergen, and Bankberg ranges, to where it dipped into the Fish River, and along that river to the sea; (*b*) the south-western region, which nearly coincided with the folded mountain belt, and stretched as a narrow zone of mountains not more than 85 miles wide from the Olifants River in the west to the Fish River in the east; (*c*) the lower Karroo region, a comparatively narrow strip of land between the southern mountain belt and the watershed, which extended from Uitenhage and Somerset East to the north end of the Bokkeveld Karroo, south of Calvinia; (*d*) the north-west coast region, which lay between the Olifants and the Orange rivers. The Orange River region consisted broadly of a hollow plain which sloped gently from east to west, with but few isolated ridges and hills scattered over its surface. It was 1000 miles long, rose to more than 3000 feet within 80 miles of the coast, and remained above this height for 250 miles in width. Seen from the tableland, the Roggeveld and other bordering mountains seemed insignificant, but seen from the Karroo the escarpment presented the appearance of a magnificent mountain range. This rose to the Drakensbergen or Kahlamba mountains in the east, 180 miles of which lay within the colony, with an average ridge level of 8000 feet. In the west, valleys containing settlements at more than 6000 feet were to be found. After a detailed examination of each region, its economic conditions were briefly discussed, and their relationship to rainfall pointed out.

The physical geography of the region further north was discussed in Mr. Tudor Trevor's paper on the physical features of the Transvaal. He divided the country into:—(1) the plateau country or High Veld; (2) the slopes of the plateau locally called Banken; and (3) the basement country locally called Low or Bush Veld. These were subdivided as follows:—

		Square miles	Per cent
High Veld	True High Veld	14,900	12·7
	Middle Veld	18,800	16·0
	Outliers (Zoutpansberg and Waterberg)	4,400	3·7
	Total	38,100	32·4
Slope Country	Main Slope	19,700	16·7
	Outliers (Zoutpansberg and Waterberg)	7,400	6·3
	Total	27,100	23·0
Low Veld		52,000	44·6
	Total	117,200	

He described the water systems and pointed out the absence of alluvial deposits, and directed attention to the steady diminution of the water in springs in recent historic times.

Mr. F. S. Watermeyer dealt with a wider area in his geographical notes on Africa south of the Limpopo. He gave a brief historical sketch of the cartography of South Africa, a summary of the history of its population, and an account of the physical features and climatic conditions, especially with regard to the influences on the development of pastoral and agricultural pursuits.

Mr. C. Stewart, Government meteorologist, communicated at Cape Town a paper on the climate of South Africa. The uniformity of mean annual temperature was pointed out—the Royal Observatory, Cradock, Bloemfontein, and Johannesburg being all about 62° F.—the higher altitude neutralising the lower latitude. The mean temperature curve was at a maximum in February; it fell rapidly until June, slightly to July, and rose with a peculiar flattening in September to the maximum. The minimum of the year occurred in a cold spell in July. The flattening in September was associated with an increase in the cloud curve coincident with the change in the prevailing winds from north-west in August to south in September. As to rainfall, there were three regions:—(1) the south-west winter rain region; (2) the small area in the south of constant rains; and (3) the east, with summer rains. Rain came with north-westerly winds in the west, with south-westerly winds in the south and east, and sometimes with north-easterly winds in the east.

Remarkable winds, locally called "Berg winds," blew from the plateau at right angles to the coast and raised the temperature. At Port Nolloth they blew when depressions were commonest in South Africa—from autumn through winter to spring—and made it warmer in winter. The storms of South Africa were associated with Λ depressions, and so were similar to those of southern Australia.

Mr. Hutchings read a paper on the indigenous forests of South Africa. He divided them into:—(1) the dense evergreen indigenous forests of which yellow-wood was the chief species, commonly called the yellow-wood forest; (2) the open timber forest, which generally occupied drier country than the yellow-wood forest, and was of inferior type, though it might contain trees of first importance, such as the cedar forest of Clanwilliam and the Rhodesian teak (*Afzelia cunanzensis*) forest of Wankie; (3) the scrub forests of the dry, hot coastlands and portions of the interior, where the rainfall was scanty and uncertain. There was no timber of large size in the scrub forests, and not much in the open timber forests. The yellow-wood forests were found in the rainy regions of the south coast, where they appeared as dense evergreen woods disposed in two storeys. The lower storey was formed by stinkwood, assegai, hard pear, ironwood, &c., and the upper storey by the large yellow-wood trees, which attained the stature and dimensions of the largest oak trees in Europe. For 1200 miles from Cape Town to the north-east Transvaal the species remained much the same, but in the Rhodesian forests most of the trees were deciduous and of different species to those of the yellow-wood forest.

Major Stevenson Hamilton, warden of the game preserves, gave an interesting account of the past and present distribution of game in the Transvaal, and of the attempts which were being made with gratifying success, to prevent its extermination.

Two papers dealt with Africa as a whole. Mr. J. Bolton discussed the boundaries and areas more particularly of British colonies and protectorates. The boundary treaties and agreements which have resulted in boundary surveys were specially treated, as these surveys are almost the only pieces of scientific map-making in the continent.

Messrs. Herbertson and Waite showed a new map of the annual rainfall of Africa, based on all available data.

Two papers were communicated on surveying and mapping. The triangulation of the gold fields was described by Mr. van der Steer, who had helped Mr. Melville, vice-president of the section, to carry out the triangulation of the central and most important section. This paper will be published in full in the *Journal of the Institute of Land Surveyors of the Transvaal.*

Colonel Johnston, late director-general of the Ordnance Survey, gave a very clear account of the history and work of the survey, and described the various maps which it issues, illustrating his remarks by specimens and by lantern slides. He pointed out the various advantages to be derived from a topographical survey of South Africa, and showed that it need not be so expensive an operation as was commonly supposed.

There were very few papers dealing with geographical exploration. At Cape Town Mr. L. Bernacchi lectured on the results of the National Antarctic Expedition with the *Discovery,* in which he paid special attention to the magnetic and meteorological results. Mr. Ferrar, another member of the expedition, gave an evening lecture at Pietermaritzburg on the same subject. A paper on the volcanic Gough Island, by Mr. Rudmose Brown, of the

Scottish Antarctic Expedition, was read at Cape Town. Two new buntings, a rich marine fauna, and three new species of plants were obtained. The desirability of further exploration from South Africa was pointed out. In the course of the discussion it was suggested that a meteorological station on Gough Island might be of use to South African weather services. Mr. Yule Oldham gave a summary of the history of the discovery of the coasts of Africa, illustrated by an admirable selection of lantern slides of contemporary maps, showing the various stages in the progress of discovery. The proceedings at Johannesburg were opened by Mr. Douglas W. Freshfield, who described the Sikhim Himalayas, and the route followed by our troops towards Lhasa; this was the only other record of travel. Mr. Freshfield delivered one of the evening lectures at Durban, choosing for his subject "Mountains."

Some interesting discussions took place on questions of physical geography at a joint meeting with the geological section, an account of which will shortly be published. At Johannesburg, Prof. Davis, of Harvard, communicated a paper on the geographical cycle in arid areas—a deductive essay based on observed facts. Starting from suggestions in Prof. Passarge's great work on the Kalahari Desert, he traced the probable sequence of land forms in an elevated and arid region rarely subjected to water erosion, illustrating his remarks by admirable blackboard sketches. He pointed out that, starting with a rough, uneven land, the occasional water erosion would not be related to sea-level, and at an early stage the depressed areas would be slowly filled up, forming lakes of rock waste. In course of time, the slopes would be so worn down and adjacent basins so filled that one communicated with its neighbour. Ultimately a large "integrated" basin would be formed; wind action would increase with smoothness, and might even transport waste outside arid area. This would waste the whole surface and reduce it to a common level, and wearing away by wind might even lower the surface below sea-level. It was suggested that wind erosion might explain the pans of the Transvaal, the origin of which had occasioned considerable speculation.

Two papers were of special interest to teachers of geography. Captain Ettrick W. Creak, F.R.S., vice-president of the section, maintained that the use of globes was essential in teaching geography, and that systematic lessons should be given with globes.

Mr. J. Lomas showed how excursions could be used in teaching geography, and illustrated his points by views taken on some excursions which he had conducted.

The committee of the section asked for the re-appointment of the committees on researches in the Indian Ocean, and on the local names given to geological and topographical features in different parts of the British Isles. They, along with sections B, C, and E, asked for the appointment of a committee to report on the quantity and composition of rainfall and the discharge of lakes and rivers in different parts of the globe.

The whole journey from England to the Victoria Falls and back may be regarded as the longest, most interesting, and most profitable geographical excursion ever made by the section. This has been described in NATURE by another pen, and so need not be recapitulated here. In South Africa the most elaborate special excursions were those arranged by the geologists, and the long trek from Pretoria to Mafeking. These permitted members to see the country more intimately than was possible from the train. The thanks of those geographers who were allowed to take part in these must be recorded.

Since the above was written, the sad news has come that the president of the section, Admiral Sir William Wharton, died at Cape Town on Thursday, September 28, after a short illness. The value of the proceedings in this section was greatly increased by his intimate knowledge of many parts of the world, by his keen interest in all geographical problems, and by the genial way in which he induced those present to take part in the discussions. An account of his career was given in NATURE of October 12 (p. 586), but the writer may be permitted to say how very much the success of the meetings of the geographical section was due to the president, whose loss will be deeply deplored by all who were privileged to come in contact with him.

THE CHELSEA POWER STATION.[1]

THE development of electric traction as applied to railways in Great Britain is about to make one more step forward with the electrification of the underground railways in London, and as this scheme is almost complete, a short description of the power scheme may be of interest.

In most large power schemes that have been completed during the last few years, it has not always been convenient to place the main power station near the centre of the system of power distribution, owing to cost of ground, &c., but this difficulty is got over by employing a number of small distributing stations which are conveniently situated in the area of supply, and are supplied with power from a large main generating station.

The main generating station of the underground electric railway will supply the entire power necessary for the working of the Inner Circle, which it is working in conjunction with the Metropolitan Railway Company's station at Neasden, and for the whole of the District Railway. It will also furnish power to the Baker Street and Waterloo, and the Great Northern, Piccadilly, and Brompton tube railways on their completion.

Coal for the boilers' furnaces is lifted out of barges by two large cranes, each working a 27-cwt. grab bucket, which deposits it in a holder where it is automatically weighed. From the holders the coal is carried by means of automatic conveyors to the coal bunkers, which are situated in the top of the boiler house immediately over the boilers. The coal falls from these through chutes to automatic stokers as required, and as the ash accumulates beneath the boiler furnaces it is removed by means of an ash railway. Thus the handling of the coal is almost wholly automatic from the moment the coal leaves the barges until it is returned to the barges as ash.

The boiler house consists of a basement and two floors, and is 450 feet long by 100 feet wide. In the basement there are eight pumps for pumping the water into the boilers. The boilers are on two floors, each containing thirty-two boilers, with floor space available for eight more boilers on each floor should they be required. They are divided into groups of eight, and each group supplies steam direct to the steam turbine engine to which it is permanently connected. Each group is fitted with economisers for heating the water before it is pumped into the boilers.

The main engine-room is 75 feet wide by 450 feet long, and consists of a basement and one floor.

The eight horizontal steam turbine engines are each coupled direct to a three-phase alternating current generator, and it seems hardly conceivable that each one of these sets is capable of transforming the heat energy of the coal into electrical energy equivalent to 7500 horse-power, while the total output of the station is 76,000 horse-power. The electrical generators are of the fixed armature type, having a four-pole revolving field, and generate at a pressure of 11,000 volts. A system of forced lubrication is employed on the turbines, thus ensuring efficient lubrication.

In addition to the above, there are four high-speed engines of 175 horse-power connected to generators which supply the magnetising current for the revolving fields. The condensing system for condensing the steam after it has performed its useful functions in the engines is very ingenious, and is so arranged that the pumps for pumping the cooling water through the condensers have merely to overcome the friction of the pipes.

One of the most interesting features of the whole system is the switch-board and control system. The system employed aims at having the entire control of the generating in a small space, and at the same time having no dangerous voltages on any part of the control board.

The system is almost analogous to the nervous system of the human body, having the control board as the brain, which it virtually is. All the big high-voltage switches are operated by small electric motors, and it is these motors which are operated from the control board, and as a low-voltage current is used for this purpose

[1] Abstract of a paper read before the students section of the Institution of Electrical Engineers by Richard F. Chaffer.